

What is claimed is:

1. A microactuator array comprising:

a plurality of first terminals equal in number to a
5 first number;

a plurality of second terminals equal in number to a
second number; and

a plurality of microactuators equal in number to the
product of the first number and the second number,

10 wherein each microactuator comprises a fixed electrode
and a movable electrode which is movable with respect to the
fixed electrode by electrostatic force,

wherein each first terminal is electrically connected
to fixed electrodes of microactuators equal in number to the
15 second number,

wherein each second terminal is electrically connected
to movable electrodes of microactuators equal in number to
the first number, and

wherein the first terminals are not connected to any of
20 the second terminals.

2. A microactuator array according to Claim 1, wherein
the microactuators equal in number to the product of the
first number and the second number are disposed in a lattice
25 in a two-dimensional plane,

wherein one end of each microactuator is fixed at the fixed electrode, and the other end of each microactuator is movable with respect to the fixed electrode and has a beam section where the movable electrode is disposed, and

5 wherein each beam section is two-dimensionally bent and a portion of each beam section is two-dimensionally superimposed on the beam section of an adjacent microactuator.

10 3. A microactuator device comprising:
the microactuator array of Claim 1; and
a controller for selectively applying a voltage to the first terminals equal in number to the first number and the second terminals equal in number to the second number.

15 4. A microactuator device according to Claim 3,
wherein, when the movable electrode of a first microactuator is driven so as to be attracted to the fixed electrode, the controller applies a voltage to the second terminal
20 connected to the movable electrode of the first microactuator and to the first terminal connected to the fixed electrode of the first microactuator so that a potential difference between the movable electrode and the fixed electrode of the first microactuator is equal to or
25 greater than a predetermined potential difference.

5. A microactuator array comprising:

a plurality of microactuators;

a first terminal group comprising a plurality of

5 terminals; and

a second terminal group comprising a plurality of
terminals,

wherein each microactuator comprises a movable section
disposed so as to be movable with respect to a fixed section,
10 a first electrode disposed at the fixed section, and a
second electrode disposed at the movable section and capable
of generating electrostatic force between the first
electrode and the second electrode by a voltage applied
between the first electrode and the second electrode,

15 wherein the movable section of each microactuator is
disposed so as to be movable between a first position where
the electrostatic force is increased and a second position
where the electrostatic force is reduced or eliminated, and
so that a restoring force for restoring the movable section
20 of each microactuator to the second position is generated,

wherein the first electrode of each microactuator is
electrically connected to one terminal of either one of the
first terminal group and the second terminal group, and is
not electrically connected to the rest of the terminals of
25 the first and second terminal groups,

wherein the second electrode of each microactuator is electrically connected to one terminal of the other of the first terminal group and the second terminal group, and is not electrically connected to the rest of the terminals of the first and second terminal groups,

wherein a combination of the one terminal of either one of the first terminal group and the second terminal group electrically connected to the first electrode of each microactuator and the one terminal of the other of the first terminal group and the second terminal group electrically connected to the second electrode of each microactuator is characteristic of each microactuator,

wherein at least one terminal of the first terminal group is electrically connected to the first electrodes or the second electrodes of at least two of the plurality of microactuators, and

wherein at least one terminal of the second terminal group is electrically connected to the first electrodes or the second electrodes of at least two of the plurality of microactuators.

6. A microactuator array according to Claim 5, wherein the number of the plurality of microactuators is equal to $m \times n$, where m and n are integers equal to or greater than 2, wherein the number of terminals of the first terminal

group is equal to m,

wherein the number of terminals of the second terminal group is equal to n,

wherein each terminal of the first terminal group is
5 electrically connected to the first electrodes or the second electrodes of n microactuators of the plurality of microactuators, and

wherein each terminal of the second terminal group is electrically connected to the first electrodes or the second
10 electrodes of m microactuators of the plurality of microactuators.

7. A microactuator device comprising:

the microactuator array of Claim 5; and

15 a controlling section which is connected to the terminals of the first and second terminal groups, and which controls switching between the positions of the movable sections of the respective microactuators by controlling electrical potentials at the respective terminals of the
20 first and second terminal groups.

8. A microactuator device according to Claim 7,

wherein the controlling section is constructed so that each terminal of the first terminal group is settable at first,
25 second, and third electrical potential states, and so that

each terminal of the second terminal group is settable at fourth, fifth, and sixth electrical potential states,

wherein the magnitudes of electrical potentials of the first to sixth electrical potential states satisfy a

5 relationship in which: the electrical potential of the first electrical potential state $>$ the electrical potential of the second electrical potential state $>$ the electrical potential of the third electrical potential state \geq the electrical potential of the fourth electrical potential
10 state $>$ the electrical potential of the fifth electrical potential state $>$ the electrical potential of the sixth electrical potential state, or satisfy the reverse relationship in magnitude,

wherein the difference between the electrical potential
15 of the first electrical potential state and the electrical potential of the sixth electrical potential state is a voltage which moves to the first position the movable section of at least one microactuator, among the plurality of microactuators, having the movable section positioned at
20 the second position when the electrical potential difference is applied between the first and second electrodes of said at least one microactuator,

wherein the difference between the electrical potential of the third electrical potential state and the electrical
25 potential of the fourth electrical potential state is a

voltage which restores to the second position the movable section of at least one microactuator, among the plurality of microactuators, having the movable section positioned at the first position when the electrical potential difference is applied between the first and second electrodes of said at least one microactuator,

wherein the difference between the electrical potential of the third electrical potential state and the electrical potential of the fifth electrical potential state and the difference between the electrical potential of the second electrical potential state and the electrical potential of the fourth electrical potential state are voltages which maintain at the first position and do not restore to the second position the movable section of at least one microactuator, among the plurality of microactuators, having the movable section positioned at the first position when the electrical potential differences are applied between the first and second electrodes of said at least one microactuator, and

wherein the difference between the electrical potential of the second electrical potential state and the electrical potential of the fifth electrical potential state is a voltage which maintains at the second position and does not restore to the first position the movable section of at least one microactuator, among the plurality of

microactuators, having the movable section positioned at the second position when the electrical potential difference is applied between the first and second electrodes of said at least one microactuator.

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9. A microactuator device according to Claim 8, wherein the first electrical potential state and the third electrical potential state are the same.

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10. A microactuator array according to Claim 5, wherein the movable section of each microactuator has an electrical current path for generating Lorentz force by disposing the electrical path of each microactuator in a magnetic field and passing electrical current.

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11. A microactuator device comprising:

the microactuator array of Claim 10;

a magnetic field generating section for generating the magnetic field; and

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a controlling section which is electrically connected to each terminal of the first and second terminal groups and the electrical current path of each microactuator array, and which controls switching between the positions of the movable section of each microactuator by controlling an

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electrical potential of each terminal of the first and

second terminal group and the electrical current flowing in the electrical current path of each microactuator array.

12. A microactuator device according to Claim 11,
5 wherein the controlling section is constructed so that each terminal of the first terminal group is settable at first and second electrical potential states and so that each terminal of the second terminal group is settable at third and fourth electrical potential states,

10 wherein the difference between an electrical potential of the second electrical potential state and an electrical potential of the fourth electrical potential state is a voltage which moves to the first position the movable section of at least one microactuator, among the plurality
15 of microactuators, having the movable section positioned at the second position when the electrical potential difference is applied between the first and second electrodes of said at least one microactuator and when a predetermined electrical current is passed through the electrical current
20 path of said at least one microactuator,

wherein the difference between an electrical potential of the first electrical potential state and an electrical potential of a third electrical potential state is a voltage which restores to the second position the movable section of
25 at least one microactuator, among the plurality of

microactuators, having the movable section positioned at the first position when the electrical potential difference is applied between the first and second electrodes of said at least one microactuator, and

5 wherein the difference between the electrical potential of the second electrical potential state and the electrical potential of the third electrical potential state and the difference between the electrical potential of the first electrical potential state and the electrical potential of
10 the fourth electrical potential state are voltages which maintain at the first position and do not restore to the second position the movable section of at least one microactuator, among the plurality of microactuators, having the movable section positioned at the first position when
15 the electrical potential differences are applied between the first and second electrodes of said at least one microactuator.

13. A microactuator device according to Claim 12,
20 wherein the first electrical potential state and the third electrical potential state are the same.

14. An optical switch array comprising:
the microactuator array of Claim 5; and
25 mirrors disposed at the respective movable sections of

the plurality of microactuators.

15. An optical switch system comprising:

the microactuator device of Claim 7; and

5 mirrors disposed at the respective movable sections of
the plurality of microactuators.

16. An optical switch system comprising:

the microactuator device of Claim 11; and

10 mirrors disposed at the respective movable sections of
the plurality of microactuators.

17. A microactuator array according to Claim 1,

further comprising mirrors for switching optical paths, each

15 mirror being disposed at a movable section including the
corresponding movable electrode of the corresponding
microactuator.

18. A microactuator device according to Claim 3,

20 further comprising:

a magnetic field generating section for generating a
magnetic field around the microactuator array,

wherein each microactuator has an electrical current
path, disposed at a movable section including the

25 corresponding movable electrode, for generating Lorentz

force in the magnetic field, and

wherein, when the movable electrode of a first microactuator is driven so as to be attracted to the fixed electrode, the controller applies a predetermined voltage to
5 the second terminal connected to the movable electrode of the first microactuator and to the first terminal connected to the fixed electrode of the first microactuator, and passes a predetermined electrical current through an electrical current path of the first microactuator.